Timber industry wood waste resources in Zimbabwe and the potential for energy generation

A. V. Herzog*[a], R. Bailis[a], T. Nhete[b], D. M. Kammen[a],
[a] Energy and Resources Group – Renewable and Appropriate Energy Laboratory, 4152 Etcheverry Hall, Berkeley, CA, 94720
phone/fax: 510-643-2243; aherzog@socrates.berkeley.edu
[b] Intermediate Technology Development Group – Southern Africa Region, Zimbabwe

Background

Zimbabwe has a large plantation timber industry of which over 90 % is based in Manicaland province, on the border of Mozambique, an area also known as the Eastern Highlands. The industry holds roughly 120,000 hectares of timber plantations stretching from Nyanga in the northeast to Chimanimani in the southeast and occupies 0.02% of the total land area of Zimbabwe, comprising 80,000 ha of pine, 24,000 ha of eucalyptus and 14,000 ha of wattle. Timber production is an important national industry, contributing from one to two percent of revenue to the gross domestic product. In addition, it is the largest employer in this region, employing about 15,000 people directly and many more indirectly. Two large private companies and one state owned actor produce about 87 % of the national output of sawn timber, while the remaining processed lumber is produced by an additional 35 medium and small mills in the region. [1]

The timber industry utilization and production of roundwood has remained fairly constant over the last decade with approximately 0.9 million m^3 of logs supplied to the sawmills per year. It is estimated that with modern timber processing technology, 60% of input raw timber can be realized as finished products. In Zimbabwe, where the technology in use is rarely state of the art, the percentage of roundwood recovered is only 40 – 45%, resulting in much higher input losses. From the initial log entering the sawmill, the output includes approximately 10 % bark, 5 % sawdust, and 45 % offcuts and chips. This is in addition to large amounts of unquantified infield waste left in the plantations. As a consequence, in the Eastern Highlands the sawmill industry produces a considerable amount of wood waste, estimated to be on the order of 500,000 m^3 annually. [2] Using a very crude calculation this waste could generate upward of 20 - 25 MW_e of power. In actuality this value will be lower as there are a number of restricting factors that need to be accounted for, such as monthly variability in residue quantity, moisture content, transportation distances, and general recoverability. Nonetheless, it points to the fact that this unused resource has considerable energy generating potential for a country currently experiencing severe power shortages.

At present, less than 10 % of this waste volume is used in boilers at the larger sawmills to generate steam for their timber-drying kilns. A very small fraction is used by the surrounding community as solid fuel. An alternative demand for chips by paper and board manufacturers, often common in industrialized countries, is minimal, as these industries have not kept pace with the growth in sawmill activities in Zimbabwe. Thus, there are large unused quantities of residues being disposed of in several ways. The principal disposal methods include dumping at the sawmill, plantation property, or municipal dumpsites, such as Mutare, the major city in the region, and being burned in tee-pee burners, or in open-air. Both situations cause adverse environmental and health affects. Runoff into nearby streams from mounds of dumped wood waste can contaminate water supplies and smoke from waste incineration adversely affects air quality. The problems have grown to such an extent that currently dumping or burning is banned by the Mutare City Council in their municipal environs, though this ban is frequently ignored. Consequently, the timber industry has often been forced to dump illegally in nearby communal lands creating the same problems in a different location. Wood waste disposal has been and will remain a major environmental problem for this region and logistical dilemma for the timber industry unless some action is taken to utilize the residues in a more productive and environmentally sensitive fashion such as clean and efficient energy generation.

Biomass Resource Analysis

We are carrying out an in-depth analysis of the wood waste produced for the purpose of assessing the economic viability of its use in power generation. We are considering bioenergy generation on various scales ranging from a village-scale unit of 50 - 100 kW up to a biomass power plant of 3 MW to be used by an individual sawmill for their power and steam requirements. Moreover, if the resources are available and institutional support is in place a large centralized biomass power plant on the order of 10 MW_e could be built to sell power to the national electricity grid as an independent power producer. While some studies have already been carried out, the spatial and temporal dynamics of the wood waste, including monthly and yearly variation in supply, moisture content, quantity and variability of the different forms of waste, as well as a detailed GPS mapping of the waste location, have yet to be systematically determined beyond macro-level estimates. We are currently compiling a comprehensive data set in order to perform a thorough analysis and determine the feasible technical options for energy generation on the scales mentioned. We will be presenting the initial results of our study with data gathered from the three largest sawmills as well as several of the medium and smaller bushmills operating in the region. Obtaining reliable statistics on the wood waste generated is essential if an investment in a biomass power generation facility is to be successful in Zimbabwe.

We are investigating both centralized and distributed electrical power generation as well as the potential for alternative fuel production schemes, such as pellets or carbonized briquettes, if there proves to be a market for such products. A variety of technologies at various stages of commercialization exist to convert raw wood waste into electrical energy or fuel and we will present an initial feasibility analysis of various options for bioenergy facilities based on their technical, environmental, and economic applicability. For example, a typical large sawmill produces approximately 70 metric tons per day of sawdust, chips, and off-cuttings. With a 20 % conversion efficiency each dry ton of biomass fuel can produce 1 MWh of electricity. This gives 70 MWh per day, equivalent to 3MW, the power requirement for a large sawmill to operate. [3] This raises the possibility of using wood wastes for direct electricity generation at the sawmills with any excess power being sold to the grid or supplied through a mini-grid to nearby communities for use in residences, commercial enterprises, or by social services institutions. The success of such scenarios is strongly dependent on being able to accurately quantifying the available biomass resource.

An additional motivation for this study, beyond environmentally sound waste disposal, is the escalating cost and reliability of electricity service in Zimbabwe, with the imminent restructuring of the national electric utility further complicating the situation. Moreover, the national grid does not serve much of the rural residential sector where communities still rely heavily on traditional biomass combustion for most of their energy needs. A preliminary analysis of the potential institutional impacts on the options for utilizing the wood waste for energy production is discussed in another abstract submitted to this conference. It reviews the input from participatory community appraisals and emerging national and regional institutional policies. [4]

References

[1] Zimbabwe Timber Producer's Federation, Yearly Zimbabwe Timber Industry Statistics, 1995 - 1999.
[2] Johnstone, W. (1998), "An Overview of the Zimbabwe Timber Industry," ITDG Sawmill Waste Workshop Proceedings (Mutare, Zimbabwe), July.
[3] Herold, A., Fritsche, U., Cames, M., and Poetzsch, S., "Wood Waste Power Plants in Zimbabwe as Options for CDM, Part II: Assessment of financial and technical feasibility studies," prepared for GTZ, March.
[4] R. Bailis, A. Herzog, T. Nhete, D. Kammen, (2001). Abstract submitted to this conference.